S. HRG. 98-548

# NAVAL PETROLEUM AND OIL SHALE RESERVE

## HEARING

BEFORE THE

SUBCOMMITTEE ON PREPAREDNESS

OF THE

## COMMITTEE ON ARMED SERVICES
## UNITED STATES SENATE

NINETY-EIGHTH CONGRESS

FIRST SESSION

ON

## S. 1810

TO AUTHORIZE APPROPRIATIONS FOR EXPLORATION, PROSPECTING, CONSERVATION, DEVELOPMENT, USE, AND OPERATION OF THE NAVAL PETROLEUM RESERVES, FOR FISCAL YEARS 1984 AND 1985

SEPTEMBER 29, 1983

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# NAVAL PETROLEUM AND OIL SHALE RESERVE

THURSDAY, SEPTEMBER 29, 1983

U.S. SENATE,
SUBCOMMITTEE ON PREPAREDNESS OF THE
COMMITTEE ON ARMED SERVICES,
*Washington, D.C.*

The subcommittee met in open session at 2:05 p.m., in room SR-222 Russell Senate Office Building, Senator Gordon J. Humphrey (chairman) presiding.

Present: Senator Humphrey.

Staff present: George K. Johnson and David S. Lyles, professional staff members; and Tamara L. Farnsworth, staff assistant.

Also present: Ron Kelly, assistant to Senator Humphrey.

[The bill, S. 1810 follows:]

[S. 1810, 98th Cong., 1st sess.]

A BILL To authorize appropriations for exploration, prospecting, conservation, development, use, and operation of the naval petroleum reserves, for fiscal years 1984 and 1985

*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,* That there is authorized to be appropriated to the Department of Energy for fiscal year 1984 for exploration, prospecting, conservation, development, use, and operation of the naval petroleum reserves under chapter 641 of title 10, United States Code, the sum of $266,100,000.

SEC. 2. There is authorized to be appropriated to the Department of Energy such sums as may be necessary for the naval petroleum reserves for fiscal year 1985.

## OPENING STATEMENT BY SENATOR GORDON J. HUMPHREY, CHAIRMAN

Senator HUMPHREY. The subcommittee meets to receive testimony on S. 1810.

It is our pleasure to have Capt. Myron Smith, who serves as Director of the Naval Petroleum and Oil Shale Reserves as our witness today for the Department of Energy.

## STATEMENT OF CAPT. MYRON E. SMITH, JR., CEC, U.S. NAVY, DIRECTOR, OFFICE OF NAVAL PETROLEUM AND OIL SHALE RESERVES, DEPARTMENT OF ENERGY

Captain SMITH. Mr. Chairman, it is my pleasure to appear before you today to discuss the naval petroleum and oil shale reserves budget request for fiscal year 1984.

I have prepared a written statement and provided it to you. With your permission, I will not read it in its entirety, but will address certain highlights contained therein.

Senator HUMPHREY. Fine.

### NAVAL PETROLEUM RESERVES PRODUCTION ACT

Captain SMITH. In 1976 the Naval Petroleum Reserves Production Act, Public Law 94-258, was passed which directed that the petroleum reserves be produced at their maximum efficient rates for 6 years ending April 5, 1982.

The 1976 act provided, for the first time, a definition of the term "national defense" as it relates to the reserves to include "the needs of, and the planning and preparedness to meet essential defense, industrial, and military emergency energy requirements relative to the national safety, welfare, and economy, particularly resulting from foreign military or economic actions."

I might add that the 1976 act provided that receipts from the sale of oil produced from the NPR's would be available for expenditures, as specified in annual appropriation acts, for the expenses of the Strategic Petroleum Reserve (SPR), the NPR's, and the National Petroleum Reserve in Alaska.

Since 1976, the NPR's have produced some $8 billion in revenues. In the same period, we have spent $1.3 billion on the NPR and $13 billion on the SPR. In short, the revenues generated by NPR's production have covered approximately 56 percent of the costs of these programs.

### PRESIDENTIAL DECISION TO CONTINUE PRODUCTION

In 1981, the President did determine that continued production of the reserves beyond April 1982 was in the national interest. His finding was based on the economic advantages of producing the reserves as compared to the limited strategic value of the reserves, and the judgment that there are more effective ways of securing the strategic advantages previously provided by the reserves.

Accordingly, production currently is authorized through April 5, 1985. We are now conducting a review to enable the President to determine whether to continue production beyond April 5, 1985. Under consideration are options from shutting in the reserves to extending production at the maximum efficient rates.

We will coordinate the review with the Office of Joint Chiefs of Staff and other appropriate Department of Defense staff members.

### PRODUCTION AND SALES OF NPR OIL

At present, NPR-1 (Elk Hills) and NPR-3 (Teapot Dome) are producing approximately 157,000 barrels of oil per day, 367.1 million cubic feet per day (MMCP/D) of natural gas, and 725.2 thousand gallons per day (MGAL/D) of liquid products.

NPR-1 reached its peak rate of production of 181,000 barrels of oil per day in July 1981.

NPR-3 reached its peak level of production of 4,600 barrels of oil per day in March 1980.

The estimated total recoverable oil reserves still available at NPR-1 and NPR-3 are 800 million and 15 million barrels, respectively, excluding additional reserves that could be recovered through enhanced oil recovery techniques or discovered by exploration.

Beginning October 1, 1983, the Department of Energy will sell 92,300 barrels of oil per day of NPR-1 crude oil directly to eight private companies at an average bonus of $1.99 per barrel over the applicable posted prices.

The remaining Government share of NPR-1 production (23,473 barrels of oil per day) and all NPR-3 production (3,000 barrels of oil per day) is expected to continue to be exchanged under the long-term contracts awarded by the Defense Fuel Supply Center (DFSC). These DFSC contracts began in December 1981 and may continue until November 30, 1986.

Senator HUMPHREY. Captain, I am going to have to interrupt you. We have a vote underway. I will be back as quick as I can. My apology.

Captain SMITH. Yes, Mr. Chairman.

[Recess.]

Senator HUMPHREY. Captain, if you will resume.

Captain SMITH. Yes, Mr. Chairman.

### FISCAL YEAR 1984 BUDGET REQUEST

With respect to the fiscal year 1984 request, active drilling, workovers, chemical treatment, pressure maintenance and enhanced oil recovery projects comprise the foundation upon which the program office rests its plans for long-term economic production from NPR-1 and NPR-3.

To this end the fiscal year 1984 budget requests funding of $266,100,000 to provide for continued production of the petroleum reserves at their maximum efficient rates. Funds are not requested for the oil shale reserves except those needed to continue land management and limited environmental monitoring activities.

With respect to the NOSR-3 Gas Production Plan, there will be six wells drilled in fiscal year 1984 which will be funded out of reprograming actions. That plan was submitted on July 29, 1983, to the House and Senate Armed Services Committees for review.

The House Armed Services Committee has indicated that it has no objections to the proposed 3-year drilling plan of a total of 14 wells.

For NPR-1 and NPR-2 the budget request is $214,946,000.

For NPR-3 the fiscal year 1984 budget request is $45,633,000.

As I mentioned, for the NOSR's the budget request is for $100,000 and provides for land management and limited environmental monitoring activities.

In fiscal year 1983, The Department of Defense allocated five additional military positions to my office to help alleviate the critical manpower shortage in petroleum engineering. This brings to eight the number of military personnel currently working with the program and includes myself and two other naval officers as well as three Air Force and two Army officers.

I am most pleased with the capability of these officers.

Mr. Chairman, this concludes my comments on the statement. I will be pleased to answer any questions.

[The prepared statement of Captain Smith follows:]

PREPARED STATEMENT OF CAPT. MYRON E. SMITH, JR., CEC, USN, DIRECTOR, NAVAL PETROLEUM AND OIL SHALE RESERVES, DEPARTMENT OF ENERGY

## I. INTRODUCTION

Mr. Chairman, it is my pleasure to appear before you today to discuss the Naval Petroleum and Oil Shale Reserves budget request for fiscal year 1984. I would like to put our request in perspective by providing some background on the Reserves, reviewing our recent program highlights and accomplishments and then presenting the major points in the fiscal year 1984 request.

## II. BACKGROUND

The Naval Petroleum and Oil Shale Reserves (NPOSR) consist of 3 petroleum reserves (two in California, one in Wyoming) and 3 oil shale reserves (two in Colorado, one in Utah). These Reserves were created by a series of Executive Orders between 1912 and 1924, and were intended to provide a source of emergency energy products for the military.

Naval Petroleum Reserve No. 1 (NPR-1, Elk Hills) is located 35 miles west of Bakersfield in Kern County, California. The Government owns approximately 78 percent of the petroleum known to exist within the Reserve, the remainder (approximately 22 percent) belonging to Chevron USA, Inc., the Government's unit partner. The Reserve is operated according to the provisions of the Unit Plan Contract (UPC) executed between the Secretary of the Navy and Standard Oil of California in 1944.

Production generally was maintained at 10,000 barrels of oil (BOPD) until World War II, when a peak production rate of 65,000 BOPD was attained for national defense purposes, as directed by a Joint Resolution of Congress. Between 1942 and 1945, approximately 27 million barrels of oil were produced at NPR-1. After the war, production was lowered to a level sufficient to meet contractual obligations and to prevent drainage off the Reserve. Just prior to open-up on July 3, 1976, this production level was approximately 2,500 BOPD.

Naval Petroleum Reserve No. 2 (NPR-2, Buena Vista Hills) is located immediately adjacent to NPR-1. The Government owns 34.6 percent of the lands within this Reserve, and virtually all of the Government's productive lands have been leased and produced continuously since 1921. Cumulative Government revenues from royalty oil produced under these leases from 1921 to the present total over $83 million. Total current production at NPR-2 is just over 2,000 BOPD, mainly from stripper wells, and over 97 percent of the recoverable oil from this Reserve has been produced.

Naval Petroleum Reserve No. 3 (NPR-3, Teapot Dome) is located 35 miles north of Casper, Wyoming in Natrona County and is 100 percent Government-owned. The Reserve was established by Executive Order in 1915. It, too, had been leased in the early 1920's, and was developed and produced until December 31, 1927, when the Reserve was shut-in following action by the Government to cancel the leases. Production totaled 3,594,000 barrels of oil between 1921 and 1927. NPR-3 essentially remained inactive until open-up in 1976.

Naval Oil Shale Reserves No. 1 and 3 (NOSR-1 and 3) were established in 1916 and 1924, respectively, and are located in Garfield County, Colorado. Naval Oil Shale Reserve No. 2 (NOSR-2) was established in 1916 and is located in Carbon and Uintah Counties, Utah. These Reserves contain an estimated 22 billion barrels of shale oil in-place. Historically, activity on the NOSR's has been limited to that associated with oil shale research at the formerly leased Anvil Points Facility on NOSR-3. In 1983, the Department of Energy (DOE) executed a contract to examine various incentives for development of NOSR-1. Based on this analysis, we do not foresee any immediate development of NOSR-1.

NOSR-3 contains essentially no shale oil and was set aside to bring the boundaries of the Reserve closer to the Colorado River and as a staging area for operations on the contiguous NOSR-1. Our analysis of commercially producing gas fields adjacent to NOSR-3 indicated the natural gas resources underlie the Reserve and could be lost due to eventual drainage from adjacent producing fields. On July 29, 1983, the Department submitted a "Plan for Protecting the Natural Gas Resources of Naval Oil Shale Reserve No. 3, Garfield County, Colorado" to the House and Senate Armed Services Committees for review. The House Armed Services Committee has indicated that it has no objections to the proposed three-year drilling program.

Following the Arab oil embargo in 1973, Congress authorized and directed in 1974 that the Petroleum Reserves be explored and developed to their full economic and productive potential. In 1976, the Naval Petroleum Reserves Production Act (Public

Law 94-258) was passed, which directed that the Petroleum Reserves be produced at their maximum efficient rates for six years, ending April 5, 1982.

The 1976 Act provided, for the first time, a definition of the term "national defense" as it relates to the Reserves to include "the needs of, and the planning and preparedness to meet essential defense, industrial, and military emergency energy requirements relative to the national safety, welfare, and economy, particularly resulting from foreign military or economic actions." I might add that the 1976 Act provided that receipts from the sale of oil produced from the NPRs would be available for expenditures, as specified in annual appropriation Acts, for the expenses of the Strategic Petroleum Reserve (SPR), the NPRs, and the National Petroleum Reserve in Alaska. Since 1976, the NPRs produced some $8 billion in revenues. In the same period, we have spent $1.3 billion on the NPR and $13 billion on the SPR. In short, the revenues generated by NPRs production have covered approximately 56 percent of the costs of these programs.

The 1976 Act also included provisions for extending production beyond April 1982 in three year increments, if the President, after an investigation is made, determines that such continued production is in the national interest. The Act specifies that the President's decision shall be forwarded to the Congress at least 180 days prior to expiration of the current production period.

In 1981, the President did determine that continued production of the Reserves beyond April 1982 was in the national interest. His finding was based on the economic advantages of producing the Reserves as compared to the limited strategic value of the Reserves, and the judgement that there are more effective ways of securing the strategic advantages previously provided by the Reserves. Accordingly, production currently is authorized through April 5, 1985. We are now conducting a review to enable the President to determine whether to continue production beyond April 5, 1985. Under consideration are options from shutting in the Reserves to extending production at the maximum efficient rates.

We will coordinate the review with the Office of Joint Chiefs of Staff and other appropriate Department of Defense staff members.

### III. RECENT PROGRAM HIGHLIGHTS AND ACCOMPLISHMENTS

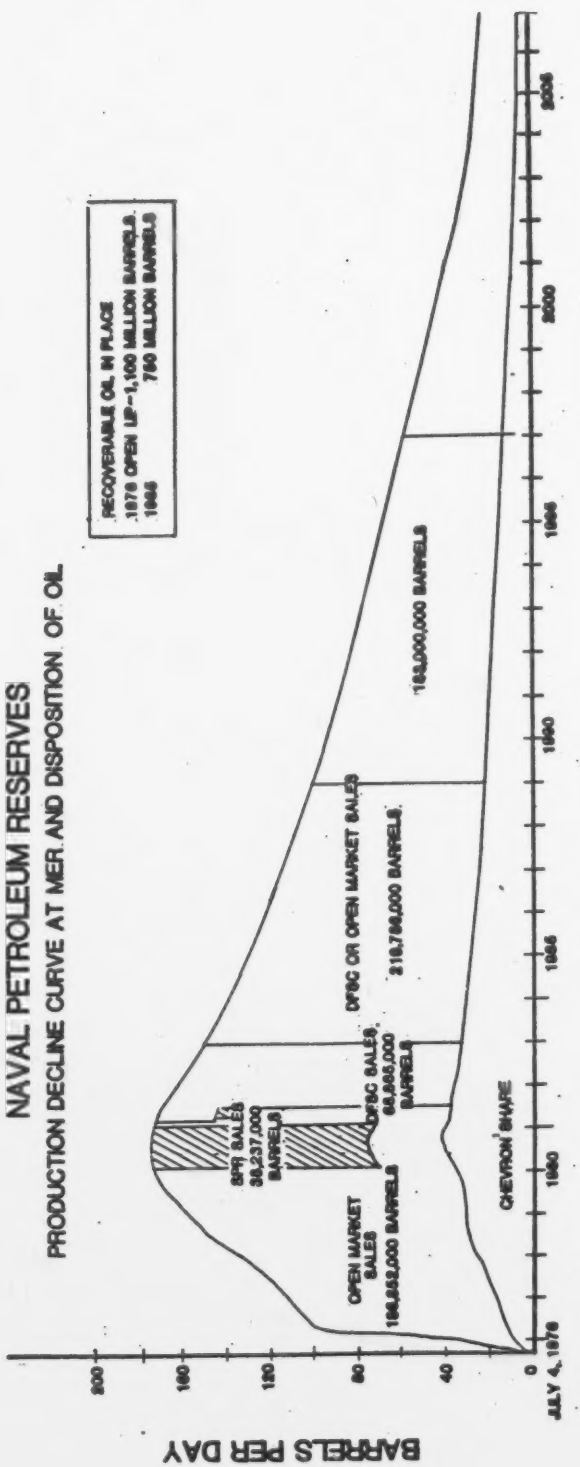
At present, NPR-1 (Elk Hills) and NPR-3 (Teapot Dome) are producing approximately 157,000 BOPD, 367.1 million cubic feet per day (MMCF/D) of natural gas, and 725.2 thousand gallons per day (MGAL/D) of liquid products. NPR-1 reached its peak rate of production of 181,000 BOPD in July, 1981. NPR-3 reached its peak level of produciton of 4,600 BOPD in March, 1980. The estimated total recoverable oil reserves still available at NPR-1 and NPR-3 are 800 million and 15 million barrels, respectively, excluding additional reserves that could be recovered through enhanced oil recovery techniques or discovered by exploration.

Over the past seven and one-half years, we have pursued an aggressive development program at NPR-1. During this time, 34 exploratory wells and 918 development wells were drilled, and production and processing facilities were significantly expanded. All major construction work on the California Development Project at NPR-1 was completed in fiscal year 1982. The single remaining major construction activity under this project involves modifications to 61 Shallow Oil Zone tank settings which are scheduled for completion by December 1983. This effort will enhance the efficiency of oil and gas production from Shallow Oil Zone wells. At NPR-3, 474 development wells and 22 exploration wells have been completed since open-up.

The drilling program was developed to respond to maturing oil fields experiencing production decline. As the reservoirs mature, additional wells are required to contain maximum efficient oil production. Additional water and gas injectors are required for pressure maintenance, along with a remedial work-over program to install pumping units in wells that once flowed under natural conditions and maintain wells in the optimum producible condition. Two enhanced oil recovery (EOR) pilot projects at NPR-3, an in-situ combustion and a polymer enhanced waterflood, were initiated in 1980 in the Shannon Reservoir. The EOR program plan also calls for additional verification of pilot results in fiscal year 1984 before the full scale devlopment can be started. Increased production due to EOR is not expected until late 1986. This program is designed to increase total potentially recoverable reserves which cannnot be produced through primary or secondary methods and to slow the rate of decline of daily oil production. The EOR program in the Shannon Reservoir has a significant potential of increasing total recoverable oil since primary and secondary methods are producing only 5 percent of the estimated oil in place.

Sales and exchanges for the Government's share of petroleum produced at the Reserves have generated over $8 billion in revenues for U.S. Treasury since open-up in 1976. Program expenditures for the same period have totaled approximately $1.3 billion, for a six to one return on investment. Total revenues for fiscal year 1983 passed $1 billion in May 1983 and are expected to reach $1.5 billion by the end of the year. Estimated program expenditures for 1983 total $224.4 million.

Since open-up in 1976, the Naval Petroleum Reserves have produced 385,000,000 barrels of oil and the Government has sold 304,000,000 barrels as its share of this oil. I will submit for the record a chart which graphically depicts the oil disposition since open-up. In addition, I am providing you a graphic display of crude oil production by year at NPR-1 since 1920.

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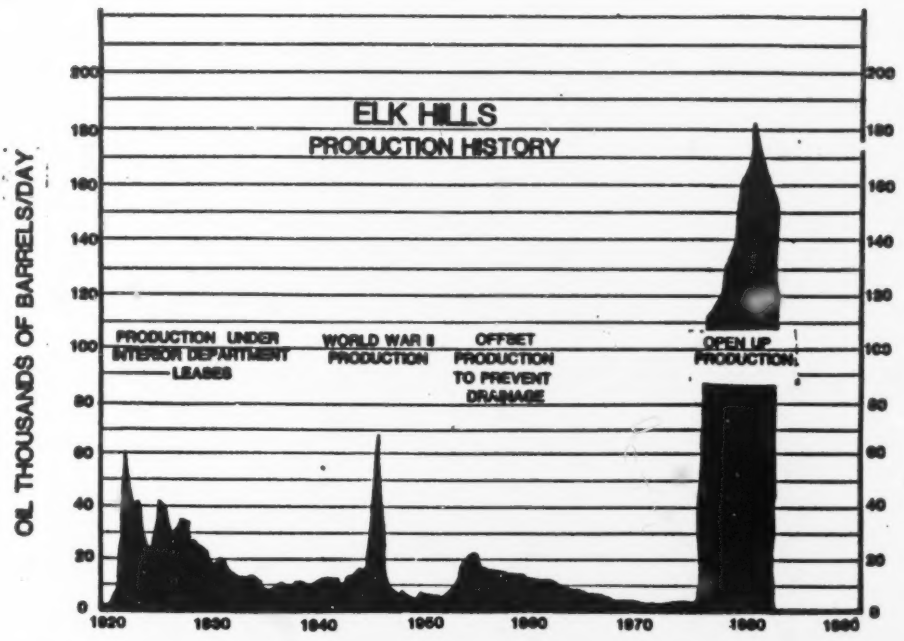


Beginning October 1, 1983, DOE will sell 92,300 BOPD of NPR-1 crude oil directly to ten private companies at an average bonus of $1.99 per barrel over the applicable posted prices. The remaining Government share of NPR-1 production (23,473 BOPD) and all NPR-3 production (3,000 BOPD) is expected to continue to be exchanged under the long term contracts awarded by the Defense Fuel Supply Center (DFSC). These DFSC contracts began in December 1981 and may continue until November 30, 1986.

Of DOE's 92.7 billion cubic foot share of natural gas expected to be produced at NPR-1 in fiscal year 1983, 41.3 billion cubic feet is being sold and the bulk of DOE's remaining share is used for re-injection to maintain reservoir pressures. As of May 1, 1983, all NPR-3 natural gas production, approximately 7 million cubic feet per day, is being used for re-injection. Prior to May 1, 1983, the Department sold 382 million cubic feet of natural gas on the open market in 1983. As the natural gas is produced with the oil, liquid products (propane, butane, and natural gasoline) are removed and competively sold.

The natural gas which is re-injected is not lost and can be produced at a later date. Of the 188.9 million gallons of liquid products expected to be produced at NPR-1 in fiscal year 1983, 188.8 million gallons will be sold and the remaining DOE share will be used or added to inventory. At NPR-3, of the total 5.1 million gallons of liquid products (propane and butane) expected to be produced in fiscal year 1983, 5 million gallons will be sold competively and the remainder will be used or added to inventory.

## IV. FISCAL YEAR 1984 BUDGET REQUEST

Active drilling, workovers, chemical treatment, pressure maintenance and enhanced oil recovery projects comprise the foundation upon which the program office rests its plans for long term economic production from NPR-1 and NPR-3. To this end, the fiscal year 1984 budget requests funding of $266,100,000 to provide for continued production of the Petroleum Reserves at their maximum efficient rates. Funds are not requested for the Oil Shale Reserves except those needed to continue land management and limited environmental monitoring activities.

*NPR-1 and NPR-2.*—The budget request for NPR-1 and NPR-2 is $214,946,000. Funding is requested in four categories: Operations and Maintenance ($113,678,000); Developing Drilling ($80,306,000); Developing Facilities ($8,458,000); and Exploratory Drilling ($12,504,000).

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Funding for Operations and Maintenance will be used to support the normal, day-to-day activities necessary to continue the maximum efficient rate of production at NPR-1. Major activities funded in this category include Production Operations ($43,777,000); Remedials ($19,562,000); and Gas Operations ($23,031,000). Production Operations provides for maintenance and repair of pipelines, tank settings, pumps, used to collect, store and distribute oil and gas; road maintenance; maintenance of water injection systems; maintenance and repair of the electrical distribution system; and other related activities.

Remedials provide for the major well work required to maintain existing wells in optimum producing condition. This includes increasing the production of wells in decline and restoring former producing wells to production. The types of remedial actions to be performed include recompletions, gas/oil ratio control, well stimulation measures, artificial lift installations, and casing failures. The fiscal year 1984 request provides for major well work to be done on 180 wells, an increase of 13 over fiscal year 1983. Remedial work in fiscal year 1984 and the outyears will concentrate efforts on converting wells which formerly flowed naturally to artificial lift. This is required to maintain production due to declining pressure in the various reservoir pools.

Gas Operations provides for operation and maintenance of all gas plants, gas injection wells, field compressor units, dry gas production, and the liquid products loading rack. It is estimated that these facilities will process approximately 353 million cubic feet of natural gas and 635 thousand gallons of liquid products per day. The request for Operations and Maintenance also includes funding for drilling supervision, technical services, administrative support and the operator fee.

Developing Drilling provides for the drilling of all development wells at NPR-1. This includes water and gas injection wells in addition to producing wells. Along with securing additional production, this program is designed to maintain reservoir and pool performance through pressure maintenance, and to further define reservoir limits. The fiscal year 1984 budget request provides for the drilling of 98 wells, an increase of 13 over fiscal year 1983. In making this request at approximately the same level of funding as the fiscal year 1983 appropriation, we have taken into consideration recent moderations in drilling costs.

The Development Facilities category provides funding for the construction of minor facilities in response to changing field conditions and requirements such as declining reservoir pressures, increased water and gas produced with crude oil, and the use of secondary and tertiary recovery methods. This includes such items as conversion of flowing wells to artifical lift, conversion of collection facilities from high to low pressure systems, and steam generation and injection facilities for the initiation of enhanced oil recovery projects. This funding maintains the same level of effort as in fiscal year 1983 in which budget authority of $3,837,000 was supplemented by $5,000,000 of carryover funding. The Exploratory Drilling request provides funds for the drilling of four Stevens Zone and one Carneros Zone wells, and continues our efforts to increase the proven recoverable reserves of the field.

*NPR-3.*—The fiscal year 1984 budget request for NPR-3 is $45,633,000, and provides funding for Operations and Maintenance ($18,215,000), the Development Program ($9,818,000), and Enhanced Oil Recovery ($17,600,000). This represents a substantial increase over the fiscal year 1983 budget due principally to a limited but expanded application of EOR development in the Shannon Zone. This includes the drilling of injection and production wells, surface facilities, operations and maintenance activities, and technical analyses required for EOR expansion. Successful application of an EOR process is expected to substantially increase recoverable reserves at NPR-3.

*NOSR's.*—The budget request for the NOSR's is $100,000. This continues the same program as in fiscal year 1984 and provides for land management and limited environmental monitoring activities.

*Program Direction.*—Funding is also requested for Program Direction salaries, benefits, travel and other related costs to support the 120 full-time equivalent employees who are assigned to the program. The fiscal year 1983 budget request for this category is $5,421,000.

The Department of Defense allocated five additional military positions to NPOSR to help alleviate the critical manpower shortage in petroleum engineering. This brings to eight the number of military personnel currently working with NPOSR, and includes myself and two other Naval officers as well as three Air Force and two Army officers. I am most pleased with the capability of these young officers.

Mr. Chairman, this concludes my prepared statement. I would be pleased to answer any questions.

NPR REVENUES

Senator HUMPHREY. Thank you, Captain Smith.

As I recall, the last time we went through all this business, by some means or other the revenues, at least to some extent, from these oil sales were being used to fill the strategic petroleum reserve; is that correct?

Captain SMITH. With respect to OMB's budget process, yes, sir.

As I indicated earlier in my comments, we have generated $8 billion in reserves so far and during that period we have spent $1.3 billion on the NPR and $13 billion has been spent on the SPR.

Senator HUMPHREY. That was through what period?

Captain SMITH. Since 1976.

Senator HUMPHREY. The Department is projecting gross revenues of $1.49 billion in 1983; is that correct?

Captain SMITH. Yes, sir.

Senator HUMPHREY. It costs $223 million to produce those revenues; is that correct?

Captain SMITH. Yes, sir.

Senator HUMPHREY. What is happening to the $1.49 billion?

Captain SMITH. That money is deposited in the general funds of the Treasury in the miscellaneous receipts account and in the windfall profits tax account.

Senator HUMPHREY. Is that used exclusively for purchases for SPR?

Captain SMITH. No, Mr. Chairman. That is part of the OMB budget balance.

Senator HUMPHREY. That is used for any purpose. So there is no money earmarked on revenues from sales on the naval petroleum reserve for SPR?

Captain SMITH. That is correct.

Senator HUMPHREY. I could swear the last time we did this somebody said that was the case.

I guess we are being asked to authorize another round of this silly game, which I don't like at all. I don't imagine you like it much either. I am not sure I am going to go along with it.

NPR PRODUCTION

This chart at the end of your testimony, I can't read the numbers at the bottom.

Where are we on this chart? Is that 1976 and 1980 is the next?

Captain SMITH. Those are year marks, Mr. Chairman.

Senator HUMPHREY. The ink is blurred on one. Does that start in 1976?

Captain SMITH. Yes, on July 4, 1976, and with each hatch mark following it showing an additional year. The upper line is the total production and also shows the decline curve of the reserves.

The lower curve is the Chevron share of production at Elk Hills and then in the area in between it shows how the oil has been disposed of since open up.

First, we had open market sales, then a portion of the oil from 1980 to 1981 went into the strategic petroleum reserve and DFSC sales, and now we will be going back to the open market sales with part of the oil still going to the DFSC.

Senator HUMPHREY. Who projects these lines into the future? Is that your office or DOD?

Captain SMITH. That is my office, my staff at both Elk Hills and Teapot Dome.

Senator HUMPHREY. Based on what? How do you know we are going to have this decline?

Captain SMITH. Based on reservoir characteristics. At Elk Hills there are roughly 50 different reservoir pools. The chart shows the collective summation characteristics of each one of the pools and the overall decline of oil production. This assumes production at maximum efficient rate (MER). This does not include any additional oil that might be gained through EOR in the future.

Senator HUMPHREY. How many days of fuel do we have in our pre-positioned war reserve?

Captain SMITH. Mr. Chairman, I am not in a position to answer that.

Senator HUMPHREY. Is that not within your jurisdiction?

Captain SMITH. No, sir.

Senator HUMPHREY. Is any of that which was put into SPR under this program before it was modified earmarked in any way for military use?

Captain SMITH. It is not earmarked for military use.

Senator HUMPHREY. I am going to submit most of these questions to you in writing to save time.

### DEFENSE PETROLEUM RESERVE STUDY

Are you in a position to comment on the study, the defense petroleum reserve study?

Captain SMITH. Yes, I can make a couple of comments on that, Mr. Chairman.

The Secretary of Energy has authorized me to study and coordinate with the Office of the Joint Chiefs of Staff and the Department of Defense on a proposal entitled "The Concept of a Defense Petroleum Reserve."

At this point the Secretary has not been briefed. We are still under study, so no policy has yet been formed.

Senator HUMPHREY. We have another vote underway. I have to leave. I don't see any necessity of continuing here. It seems to me a good idea that if we are going to be pumping the oil, we ought to put it in a place specifically earmarked for the military. Otherwise we are wasting an important military reserve. I am pretty tired of it.

Thank you.

Captain SMITH. Thank you, Mr. Chairman.

[Questions submitted by Senator Gordon J. Humphrey, answers supplied by Capt. Myron E. Smith, Jr., Director, Naval Petroleum and Oil Shale Reserves, Department of Energy.]

### QUESTIONS SUBMITTED BY SENATOR GORDON HUMPHREY

Senator HUMPHREY. Captain Smith, in your statement you pointed out that the Department of Energy had executed a contract to examine various incentives for development of the Oil Shale Reserves. Would you outline for the record some of the problems in developing or producing oil from the Oil Shale Reserves and the cost of such production?

Captain SMITH. The size and richness of the shale resource base on Naval Oil Shale Reserve No. 1 (NOSR-1) make it a relatively attractive location for construction of a shale oil production facility. Unfortunately, shale oil presently is at an absolute cost disadvantage with competing forms of fuel. At the time we contracted to study the various means of subsidizing private development on NOSR-1, we perceived that the land and the environmental studies performed by the Government might be enough incentive to entice a private enterprise partner into a venture. However, the study, performed by Hagler, Bailly & Company concluded that private development would require minimally acceptable prices far above oil prices, even if the raw land and shale were assigned a zero value. At this time, oil shale development on NOSR--1 is impeded by the same economic factors which are preventing private companies from developing their own land tracts. Specifically, the cost of producing oil from shale is estimated to be at least one and one-half times greater than the present market value of crude oil. Two major variables which could change this situation are a drop in interest rates and a rise in the world price of oil. A third variable which could possibly aid shale development would be technological advances in retorting, however, we do not perceive any major advances on the horizon.

Senator HUMPHREY. Would you describe for the record the steps necessary to protect the natural gas resources of Naval Oil Shale Reserve No. 3?

Captain SMITH. Private development of the Rulison gas field which borders on and appears to underlay Naval Oil Shale Reserve No. 3 (NOSR-3) has proceeded to the point where gas is being produced from land immediately adjacent to NOSR-3. The pressure differentials resulting from this production have a high likelihood of causing the natural gas to migrate off of the Reserve to the privately owned wells. The most reasonable action we can take is to drill and produce wells along the border of the Reserve. This should result in an equalization of the reservoir pressures on both sides of the Reserve's boundary, thereby halting the possible migration of the natural gas.

To that end, we submitted to the Senate and House Armed Services Committees on July 29, 1983, a "Plan for Protecting the Natural Gas Resources Naval Oil Shale Reserve No. 3, Garfield County, Colorado." It proposes that 14 wells be drilled along the southeast boundary of the Reserve to offset existing commercial development. It is planned that the first wells would be drilled next spring. If there is continued development along this boundary of the Reserve, of course, additional wells might be needed to protect the Reserve's natual gas resources. We intend to limit our work on NOSR-3 to the minimum needed to protect our interest in natural gas at the Reserve.

Senator HUMPHREY. In your statement, you indicate that only 5 percent of the estimated oil in place can be recovered by primary and secondary methods of production. Does this mean that the 800 million barrels of recoverable oil in Naval Petroleum Reserve No. 1 represents only 5 percent of the oil in place?

Captain SMITH. No, the 5 percent figure applies only to the Shannon Zone of Naval Petroleum Reserve No. 3 in Wyoming. In that zone, we estimate 180 million barrels of oil were originally in place. Using primary recovery techniques, we estimate that only 9 million barrels would be recovered. That large pool of oil remaining in the Shannon Zone is the basis of our plans to use enhanced recovery techniques if they prove cost effective.

The 800 million barrel figure is our estimate of total recoverable oil from Naval Petroleum Reserve No. 1 in California. We expect that individual reservoirs at NPR-1 can be produced to recover between 30-45 percent of the oil in place by primary and secondary techniques.

Senator HUMPHREY. Captain Smith, would you describe for us the various types of enhanced oil recovery methods now in use and those that are under study? Would you also indicate those you think have the greatest potential in the future?

Captain SMITH. The petroleum industry is experimenting with many different types of enhanced oil recovery (EOR) techniques. Based on reservoir engineering studies, we have determined to test three techniques, two in Wyoming and one in California.

The Wyoming pilot projects include an in situ fireflood and a polymer-enhanced waterflood. Although the Shannon Zone of Naval Petroleum Reserve No. 3 is reasonably porous, there is insufficient natural energy to bring the oil to the surface. Both the fireflood and polymer waterflood are attempts to push the oil uniformly to producing wells by increasing pressure in the reservoir. In the fireflood, pressure is created by burning oil in the ground; in the waterflood, water containing a polymer is injected under pressure into the producing formation. Both of these techniques have had success in other fields. Both tests experienced unavoidable delays. Both

are now operating well and recommendations about broad application of these techniques will be made after the tests are completed.

The technique being studied at Naval Petroleum Reserve No. 1 in California is the injection of steam under pressure. This technique is widely used for the production of heavy oil in southern California and is also being applied to lighter oils. Its advantage is that steam both reduces the viscosity of the oil and also provides an efficient flooding mechanism for driving the oil to producing wells. This technique is used in a pilot project by Chevron U.S.A., our unit partner, in a neighboring field in the same producing horizon. Based on Chevron's results, to date, we have high hopes for a successful pilot project. From the perspective of the Office of Naval Petroleum and Oil Shale Reserves, the steam flooding technique holds the greatest promise in California to increase the amount of recoverable oil.

Senator HUMPHREY. Captain Smith, do you foresee a point in the not too distant future when the production of deep sea oil reserves will become cost effective and do you feel that will be more cost effective than developing oil shale reserves?

Captain SMITH. The Naval Petroleum and Oil Shale Reserves Office has no cognizance over deep sea oil reserves which are set aside for use by the Federal Government. Nor do we formally monitor the technical and cost developments which will influence deep water drilling. I, therefore, am unable to form an opinion as to the comparative economics of deep sea petroleum versus shale oil production.

Senator HUMPHREY. Captain Smith, would you give us some background on the Strategic Petroleum Reserve to include the current balance, fill rate, and priorities for withdrawing from the Reserve?

Captain SMITH. The Strategic Petroleum Reserve (SPR), authorized by the Energy Policy and Conservation Act of 1975, is intended to reduce the impact of disruptions in supplies of petroleum products or to carry out obligations of the United States under the International Energy Program. Currently, the SPR consists of five sites containing crude oil inventory, one site (Big Hill, Texas) being developed for crude oil storage, and a government-owned marine terminal.

As of October 5, 1983, the Reserve has an inventory of 361 million barrels of crude oil. The development plan for the SPR is to reach 750 million barrels by fiscal year 1991. During fiscal year 1983, the SPR was filled at a rate of 227,700 barrels per day.

Both the Energy Policy and Conservation Act and the SPR Plan Amendment 4, the SPR Drawdown Plan, require a Presidential decision that drawdown is required due to "a severe energy supply interruption or by obligations of the United States under the International Energy Program." (EPCA Sec. 161 (d)).

Use of the SPR will be part of a total interruption response, and the extent of its use is likely to change throughout the course of an interruption. The primary purpose of the SPR will be to provide additional supplies of petroleum to domestic energy markets on a timely basis to substitute for supplies interdicted due to a major fuel supply disruption, thereby helping to dampen price increases at least temporarily in times of disruption.

There will be two options for selection of buyers of SPR oil. The basic method will be by price competitive sale with awards going to the highest bidders. The Secretary may establish a minimum acceptable price. The plan also authorizes the Secretary to direct the distribution of up to 10 percent of the volume of SPR oil sold in that calendar month at the average price of SPR oil sold competitively.

This plan for SPR inventory withdrawal is based on the policy that market mechanisms, not price and allocation controls, must be relied upon to respond to energy shortages most efficiently and effectively.

Senator HUMPHREY. Is storage in salt dome efficient in regard to rapid recovery?

Captain SMITH. Crude oil stored in man-made salt caverns, such as those used for the Strategic Petroleum Reserve (SPR), can be withdrawn at a more rapid rate than could equivalent quantities of crude oil in natural geologic reserves such as those in Elk Hills, Calif.

The production rate at Elk Hills is about 150,000 barrels per day, whereas the current SPR drawdown rate is 1.7 million barrels per day and will rise up to approximately 3 million barrels per day. That is 20 times greater than the current Elk Hills production rate, and as the drawdown capability of the SPR sites increases and production from the Naval Petroleum Reserves continues to decline, that ratio will increase.

In addition to the actual rate of removal of the oil from the storage container, consideration must be given to the geographic location of the storage in relation to crude oil demand centers and transportation systems. Strategic Petroleum Reserve sites have been located near refinery centers and have access to both interstate pipeline and marine terminal facilities.

Senator HUMPHREY. Captain Smith, would you provide for the record a list of revenues versus expenditures involving the Reserves from 1977 to the present and a forecast of the same figures through 1988?

Captain SMITH. Actual revenues and expenditures for NPOSR from 1977 through 1982, along with projected estimates for 1983 through 1988 are provided below. Also provided are outlays for the SPR. As you will recall, when production of the NPR's began in 1976, the receipts were then linked to spending on the SPR as well as the NPR's.

## REVENUES AND EXPENDITURES

[In millions of dollars]

| Fiscal Year | Gross revenues [1] | Expenditures [2] | | Total expenditures |
|---|---|---|---|---|
| | | NPR | SPR | |
| 1977 | 402.9 | 115.3 | 122.0 | 237.3 |
| 1978 | 505.7 | 151.0 | 897.1 | 1,048.1 |
| 1979 | 754.5 | 172.4 | 1,020.7 | 1,192.7 |
| 1980 | 1,590.5 | 146.8 | 342.0 | 488.8 |
| 1981 | 1,666.4 | 211.0 | [3] 3,822.3 | 4,033.3 |
| 1982 | 1,606.8 | 244.8 | 3,877.4 | 4,122.2 |
| 1983 [4] | 1,532.2 | 219.9 | 1,948.8 | 2,168.7 |
| 1984 | 1,376.9 | 250.9 | 1,779.8 | 2,030.7 |
| 1985 | 1,377.7 | 329.7 | 1,347.5 | 1,677.2 |
| 1986 | 1,401.7 | 356.2 | 1,311.6 | 1,667.8 |
| 1987 | 1,382.3 | 373.1 | 1,369.9 | 1,743.0 |
| 1988 | 1,350.6 | 388.6 | 1,404.0 | 1,792.6 |

[1] Revenues for fiscal year 1984 do not reflect new contract prices. Revenues in the out-years are based on fiscal year 1983 mid-session review.
[2] Expenditures for fiscal year 1984 are based on the fiscal year 1984 negotiated scope of work, projected work schedules and historical spending trends. Expenditures for the outyears are based on projected activities to be accomplished and historical spending trends.
[3] Includes outlays of $508.3M from SPR entitlements and royalities.
[4] Includes actuals through August 1983.

Senator HUMPHREY. If revenues exceed expenditures by a large margin; what becomes of these revenues?

Captain SMITH. If NPR revenues exceed expenditures, the excess is used to reduce the Federal budget deficit. Revenues from the sale of petroleum (crude oil, natural gas and liquid products), reimbursement from Chevron U.S.A. Inc., for its share of the costs of operations, NPR-2 lease royalties, pipeline usage fees, and grazing fees are transferred to the Department of Treasury for deposit in either the miscellaneous receipts account or the Windfall Profit Tax account. Like other government receipts, they reduce the need for Treasury to borrow money to pay for Government programs and reduce the budget deficit.

Senator HUMPHREY. What is the current rate of production of the Naval Petroleum Reserves?

Captain SMITH. The current rate of production for fiscal year 1983, along with the projected estimates for fiscal year 1984-fiscal year 1988, are provided in the attached tables. The projected estimates do not take into account any increased production resulting from possible field-wide application of enhanced oil recovery technologies.

## NAVAL PETROLEUM RESERVES CRUDE OIL PRODUCTION (BOPD)

| | NPR-1 production | NPR-1 Government share | NPR-2 production | NPR-2 royalty share | NPR-3 production | Total [1] Government share |
|---|---|---|---|---|---|---|
| Fiscal year: | | | | | | |
| 1983 [2] | 157,600 | 122,300 | 5,277 | 248 | 2,899 | 125,447 |
| 1984 | 145,748 | 113,859 | 4,915 | 231 | 2,634 | 116,724 |
| 1985 | 137,599 | 107,558 | 4,553 | 214 | 2,634 | 110,406 |
| 1986 | 130,335 | 101,908 | 4,255 | 200 | 2,970 | 105,078 |
| 1987 | 120,959 | 94,550 | 3,936 | 185 | 2,581 | 97,316 |
| 1988 | 111,720 | 87,266 | 3,660 | 172 | 2,161 | 89,599 |

[1] Total includes NPR-1 Government share, NPR-2 Government royalty share, and all NPR-3 production.
[2] Actual through August, 1983.

## NAVAL PETROLEUM RESERVES

| | Liquid products production (G/D) | | | | Natural gas production (MCF/D) | | | |
|---|---|---|---|---|---|---|---|---|
| | NPR–1 total production | Government share [1] | NPR–3 total production [1] | Total Government share [1] | NPR–1 total production | Government share [1] | NPR–3 total production [1] | Total Government share [1] |
| Fiscal year: | | | | | | | | |
| 1983 [2] | 645,650 | 517,500 | 14,000 | 531,500 | 329,400 | 113,300 | 7,000 | 120,300 |
| 1984 | 636,566 | 512,997 | 16,500 | 529,497 | 348,164 | 122,874 | ..... | 122,874 |
| 1985 | 640,072 | 525,728 | 20,500 | 536,228 | 347,586 | 122,256 | ..... | 122,256 |
| 1986 | 613,798 | 494,659 | 20,500 | 515,159 | 342,068 | 127,209 | ..... | 127,209 |
| 1987 | 583,697 | 470,566 | 20,500 | 491,066 | 334,509 | 125,050 | ..... | 125,050 |
| 1988 | 548,347 | 442,293 | 20,500 | 462,793 | 323,704 | 119,795 | ..... | 119,795 |

[1] Reflects quantity sold.
[2] Actual through August 1983.

Senator HUMPHREY. What is the maximum rate of recovery if all practicable forms of enhanced recovery techniques are utilized?

Captain SMITH. Due to the uncertainty of success with the three pilot projects currently in progress, we cannot project specific rates of production which would be associated with the EOR programs. However, I would like to clarify that Naval Petroleum Reserve No. 1 in California reached its peak production in 1981 and is now in decline. Even if an EOR program should become a major success, it will take several years to have a substantial impact. In the meantime, the average production rate will continue to fall. Barring a major new reservoir discovery, waterflood and enhanced recovery operations at NPR–1 will not result in production above current rates, but will act to delay the decline.

The situation at Naval Petroleum Reserve No. 3 (NPR–3) is somewhat different, and a successful EOR program may actually increase production above current rates. However, it should be kept in mind that current production from NPR–3 is approximately 3,000 barrels of oil per day, and a doubling of this rate, although impressive, in terms of percentages, would not be significant in a national strategic sense.

Senator HUMPHREY. Since the Naval Petroleum Reserves cannot meet our wartime needs, what are the alternatives? Should we consider the alternative of utilizing or adding to the Strategic Petroleum Reserves?

Captain SMITH. It is true that the Naval Petroleum Reserves are of limited strategic value for meeting Defense wartime needs. There currently are a number of means available to DOD for meeting Defense wartime needs, including:

Normal procurement channels are DOD's first line of supply assurance for meeting its wartime needs.

U.S. crude oil production is currently averaging some 8 million barrels per day (B/D). In times of mobilization or other military emergency, DOD would have priority access to this oil by invoking the Defense Production Act.

In addition to domestic production and other production from relatively secure sources elsewhere in the World, DOD can draw on its prepositioned war reserves.

The Strategic Petroleum Reserves Distribution Plan contains an optional 10 percent directed sale provision. Once the President has made the necessary findings to drawdown the SPR, the Secretary of Energy may use his discretion to direct that up to 10 percent of monthly SPR sales go to a particular segment of the economy, including the military.

DOD could also bid for SPR crude oil and make arrangements with refiners to produce militarily useful product from it. Alternatively, DOD might simply buy product from those refiners who successfully bid for the SPR crude.

In short, we are confident that DOD petroleum needs can and will be met in time of mobilization or other military emergency.

Regarding the option of adding to the SPR to help meet DOD needs, we are looking at options designed along these lines. One such option is the creation of a so-called Defense Petroleum Reserves (DPR). It would be similar to the SPR but dedicated to DOD use. Its principal objective would be to provide an assured source of petroleum to DOD during periods short of mobilization and/or conditions which would permit the drawdown of the SPR. This "quick reaction" reserve would be capable of meeting some or all of DOD's emergency needs since it would have much

higher drawdown rate than would be obtained through the NPR production capabilities.

To date only preliminary study of the DPR option has been completed. Additional study must be done to determine if a DPR is necessary and whether the benefits that would be derived from a DPR outweigh the cost involved and the resulting increase in the budget deficit. As a matter of general budget policy, the administration opposes earmarking receipts so a SPR, if it does prove attractive, would have to be financed through appropriations.

PREPOSITIONED WAR RESERVES

Senator HUMPHREY. How many days of fuel do we have in our prepositioned war reserves?

Captain SMITH. Regional prepositioned war reserve requirements vary according to the distance from the U.S. Gulf Coast, considered the most secure source of resupply in wartime. The data below, while generalized for all products and masking some differences within regions, indicate the extent to which DOD has been able to preposition fuel assets in specific regions against the prepositioning requirement for those regions:

| Region | Required days | On hand days |
|---|---|---|
| Central Europe | [Deleted] | [Deleted.] |
| Mediterranean | | |
| Korea | | |
| Southwest Asia | | |
| Southern Command | | |

Note.—In some cases, malpositioned war reserves are included in the on-hand quantities above. Malpositioned stocks are those that are intended for use in a specific area but due to storage facility limitations are temporarily stored considerable distances away in storage that is available.

WARTIME PETROLEUM REQUIREMENTS

Senator HUMPHREY. What are their wartime petroleum requirements?

Captain SMITH. Current plans estimate that direct defense refined petroleum product requirements for a global-scale war would be on the order of [deleted] barrels per day. This does not include the petroleum requirements of defense industry or defense-related transportation requirements.

CONTINGENCY FUEL REQUIREMENTS

Senator HUMPHREY. How many barrels of stored accessible petroleum are required to prevent us from immediate depletion of our war reserves in a crisis?

Captain SMITH. Even in a total disruption of refined petroleum products to DOD, there would be no immediate depletion of war reserves. The normally-available peacetime operating stocks would provide some cushion, although not a comfortable one.

In very general terms, for the highest consumption fuel (JP-4), DOD currently has 35 to 45 days of operating stocks in overseas areas. JP-4 jet fuel consumption is approximately 50 percent of the total DOD petroleum consumption. Hypothetically, DOD could survive a total fuel disruption for 45 days before reaching war reserve levels. Of course, some locations would reach war reserves earlier and later than others. The experience of 1979 is illustrative. The fuel disruption prompted by the Iranian Revolution ultimately affected DOD inventories in that some existing suppliers could not fulfill their contracts and numerous potential suppliers, concerned about crude oil availability, refrained from offering product on new DOD contracts. The loss of most Iranian crude to the world oil market occurred in early 1979. DOD records indicate that individual locations began dipping into their war reserves in March 1979 and there were theater-wide "penetrations" of war reserves by June of that year. It should be remembered that the 1979 disruption took only 2 to 3 million barrels of crude out of the market.

Assuming that the question refers to crude petroleum to be readily accessible for refining (as opposed to refined petroleum products prepositioned as war reserves in the theaters of operations), the following table depicts selected sizing options. The assumptions are that peacetime consumption is .5 million barrels (MMBBLS) and that it requires 1.3 barrels of crude to produce one barrel of militarily-useful refined product:

| Tempo of operations | Shortfall | Duration (days) | Reserve size (million barrels) |
|---|---|---|---|
| Peacetime (1.0) | 0.25 | 90 | 15 |
| Do | 0.25 | 180 | 29 |
| Do | 0.25 | 365 | 59 |
| Do | 0.5 | 180 | 59 |
| Do | 0.5 | 365 | 119 |
| Do | Total (1) | 180 | 117 |
| 1.25 | 0.25 | 365 | 74 |
| 1.25 | 0.5 | 365 | 148 |
| 1.5 | 0.5 | 180 | 88 |
| 1.5 | 1 | 180 | 176 |

Note.—These selected "tempo of operation" rates are for circumstances far short of total war. Wartime rates would be considerably greater.

### DOD PEACETIME PETROLEUM REQUIREMENTS

Senator HUMPHREY. What are the Department of Defense peacetime petroleum requirements?

Captain SMITH. Department of Defense (DOD) peacetime petroleum requirements are approximately 490,000 barrels of refined product per day. Of that total, some 67 percent is jet fuel, 20 percent distillate, 3 percent motor gasoline, and 10 percent residuals.

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### QUESTION SUBMITTED BY SENATOR CARL LEVIN; ANSWER SUPPLIED BY CAPT. MYRON SMITH, JR.

Senator LEVIN. Captain Smith, is the $266.1 million you are requesting for operation of the naval petroleum reserves in fiscal year 1984 based on any assumptions about continued production of the reserves after April 5, 1985?

In other words, would you be asking for this full amount regardless of the recommendation of the President on whether to continue production of the naval petroleum reserves for an additional 3 years?

Captain SMITH. The current authority to produce the naval petroleum reserves runs to April 5, 1985; therefore, our fiscal year 1984 request, which offsets production through September 30, 1984, is not affected by the issue of whether to continue production after April 1985.

Senator HUMPHREY. The subcommittee is adjourned.

[Whereupon, at 2:30 p.m., the subcommittee adjourned, subject to the call of the Chair.]

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